Aging Clin Exp Res 17: 276-280, 2005
©2005, Editrice Kurtis

Upper extremity fractures in the elderly: consequences on utilization of rehabilitation care

Anne Lübbeke[1], Richard Stern[1,2], Bernard Grab[2], François Herrmann[2], Jean-Pierre Michel[2], and Pierre Hoffmeyer[1]

[1]Service de chirurgie orthopédique et traumatologie de l'appareil moteur, [2]Département de Réhabilitation et Gériatrie, Hôpital Cantonal Universitaire de Genève, Geneva, Switzerland

ABSTRACT. ***Background and aims:*** *While hip fractures represent the most dramatic consequence of osteoporosis, fractures of the humerus, forearm and wrist account for one-third of the total incidence of fractures due to osteoporosis in the older population. The aim of this retrospective cohort study was to evaluate rehabilitation care utilization and associated factors in elderly individuals with upper limb fracture.* ***Methods:*** *Over two years, 667 patients 65 years of age or older were studied, who presented to the emergency department either from their private homes or nursing homes with an upper extremity fracture. The following outcome variables were collected: gender; age; residence; location of fracture; treatment; discharge destination; length of hospitalization; length of stay in a rehabilitation facility; and ultimate place of habitation after the event.* ***Results:*** *The most frequent sites of fracture were distal radius (37.2%) and proximal humerus (29.1%). Two-thirds of the patients were treated non-operatively. Inpatient rehabilitation care was necessary for 248 patients (37.2%; length of stay, 46 days). Factors associated with increased care included older age (≥80 years), coming from private home, sustaining two fractures, fractures of the humerus, and operative treatment. Six percent of the patients required permanent nursing home care.* ***Conclusions:*** *Upper extremity fractures in older people often require prolonged hospitalization and therefore account for considerable health care costs. Reasons are more related to advanced age and living conditions than to particular injury or treatment.*
(Aging Clin Exp Res 2005; 17: 276-280)
©2005, Editrice Kurtis

INTRODUCTION

Osteoporosis is clearly recognized as a major cause of morbidity and disability in older people of both sexes, but most of the focus has traditionally been on fractures of the proximal femur (1-4). The reason for this is probably because a fracture of the hip represents the most dramatic consequence of osteoporosis and by its very nature demands urgent treatment. Information concerning fractures at other anatomic sites has been less frequently reported, with the focus on vertebral fractures and fractures of the proximal humerus and distal radius (5-9). Fractures of the humerus, forearm and wrist account for one-third of the total incidence of fractures due to osteoporosis in the elderly population (10-12). Although an upper extremity fracture does not prevent ambulation, it does nevertheless play a significant role in depriving patients of an independent existence, mostly temporary but sometimes definitive. Osteoporotic fractures result in considerable health care costs (13, 14), rehabilitation hospital costs comprising a large proportion. However, we are unaware of detailed discussion about the health-care burdens of upper extremity fractures in the older population. The aim of this study was to describe this population and to analyze factors leading to rehabilitation care utilization.

METHODS

This is a retrospective study of a cohort of 667 patients, 65 years of age or older, who presented to a University Hospital emergency department between January 1999 and December 2000 with a fracture of the upper extremity. This Hospital is the only public hospital in this area and includes both acute and rehabilitation care. We excluded patients who sustained their fracture from a high-energy injury or were polytraumatized, those with pathological fractures, or patients with fractures of the hand (carpal bones, metacarpals, phalanges). The patients enrolled in this study were obtained from a review of all the emergency room records for this time period.

For all patients, the following outcome variables were col-

Key words: Older person, osteoporotic fracture, rehabilitation care, upper extremity fracture.

Correspondence: R. Stern, MD, Service de chirurgie orthopédique et traumatologie de l'appareil moteur, Hôpital Cantonal Universitaire de Genève, 24, rue Micheli-du-Crest, 1211 Genève 14, Switzerland.
E-mail: richard.stern@hcuge.ch

Received May 17, 2004; accepted in revised form November 26, 2004.

lected: gender; age; place of residence; location of fracture and presence of any additional fractures (additional upper and/or lower extremity); treatment; discharge destination; length of stay for those hospitalized; length of stay in short- and/or long-term rehabilitation (if any); and ultimate place of habitation after the event, specifically looking at those patients who had to make a permanent change in residence after their fracture. The retrospective study did not review all patients at a specified time, but only until they returned either to their previous residence or to a more care-intensive permanent residence.

Patients included in this study arrived at the emergency department from one of two sources, either from their private homes or from nursing homes. The diagnosis of an upper extremity fracture was made and three possible pathways were determined for each patient: (I) Patients were treated in the emergency department and discharged back to their previous residence; (II) Patients were treated in the emergency department, but were considered unable to return to their previous residence and were sent directly to rehabilitation. In many cases, this was necessary because they could not be managed on an outpatient basis (had sustained two fractures, were incapable of independent functioning, etc.) or had associated medical problems requiring treatment; and (III) Patients needed surgery for their fracture and were admitted to the orthopedic unit of the hospital. In this latter group of patients the same two pathways were possible, either returning to their previous residence or requiring additional care in rehabilitation.

Our patient population was divided into two groups depending upon their use of rehabilitation care, and the factors leading to one treatment or the other were analyzed.

Statistical analysis

Mean, median, standard deviation (SD), and interquartile range (IQR) were reported for continuous variables. The Mann-Whitney U-test was used to compare the distribution of continuous variables. The Chi-square trend test was used to compare multiple samples of a binary outcome. Effect estimates were calculated as odds ratios (OR) with their 95% confidence intervals. The variable "age" was stratified into two subgroups and linear regression was used to examine interactions between two related variables expressed as percent difference in absolute increase and their 95% confidence interval. Univariate and multivariate logistic regression analysis was performed to identify risk factors associated with the use of rehabilitation.

RESULTS

Six hundred and sixty-seven patients with an upper extremity fracture, 65 years of age or older, were included in the two-year study period. Their characteristics are listed in Table 1. The mean age of the group as a whole was 80.0 (±8.2) years and there was a high percentage of women (86.4%).

The two most frequent sites of fracture were the distal radius (n=248; 37.2%) and the proximal humerus (n=194, 29.1%). Ninety-seven patients (14.5%) sustained two fractures, either an additional upper extremity fracture (n=40; 6.0%) or an additional lower extremity fracture (n=57; 8.5%). Of this latter group, there were 37 (64.9%) fractures of the hip and 9 (15.8%) fractures of the pelvis. When one looks at the anatomical location of the upper extremity fracture by gender, we see that no

Table 1 - *Basic characteristics of study patients.*

	Number (%)	Proportion of women	Proportion of surgical treatment
All patients	667 (100)	86.4	33.0
Mean Age (±SD)	80.0 (±8.2)		
Age (%)			
<80yrs	323 (48.4)	87.6	39.0
≥80yrs	344 (51.6)	85.2	27.3
Previous Residence (%)			
Private home	517 (77.5)	85.5	35.6
Nursing home	150 (22.5)	89.3	24.0
Fracture Site (%)*			
One Fracture			
Shoulder girdle[1]	24 (3.6)	75.0	8.3
Proximal humerus	194 (29.1)	87.6	21.6
Humeral shaft	29 (4.3)	58.6	31.0
Elbow[2]	51 (7.6)	82.4	68.6
Forearm	24 (3.6)	100.0	37.5
Distal radius (wrist)	248 (37.2)	88.7	23.0
Two Fractures			
Upper+Upper Extremity	40 (6.0)	85.0	47.5
Upper+Lower Extremity	57 (8.5)	89.5	82.5

[1]Fractures of scapula, clavicle; [2]Fractures of distal humerus, proximal ulna, proximal radius.

Aging Clin Exp Res 17: 276-280, 2005
©2005, Editrice Kurtis

Table 2 - *Rates (%) of rehabilitation care utilization, and crude and adjusted OR according to patient characteristics.*

	Patients exposed (n)	Rehabilitation required (%)	Crude OR (95% CI)	Adjusted OR (95% CI)*
Age				
<80yrs	323	28.2		
≥80yrs	344	45.6	2.14 (1.55-2.95)	3.29 (2.20-4.93)
Gender				
Men	91	30.8		
Women	576	38.2	1.39 (0.86-2.24)	1.59 (0.91-2.77)
Previous Residence				
Nursing home	150	22.7		
Private home	517	41.4	2.41 (1.58-3.67)	3.16 (1.90-5.28)
Type of Injury				
One Fracture	570	32.6		
Two Fractures	97	63.9	3.66 (2.33-5.73)	**
Fracture Site*				
Others	347	25.4		
Humerus	223	43.9	2.31 (1.61-3.30)	2.31 (1.58-3.37)
Treatment*				
Non-operative	416	31.3		
Operative	154	36.4	1.89 (1.36-2.63)	1.59 (1.03-2.43)

*Only including patients with one upper extremity fracture (n=570); **Dropped due to collinearity.

male patient sustained a fracture of the forearm, but they did have a proportionately higher number of fractures of the humeral shaft when compared with the women.

More than three-quarters of the patients came from private homes (n=517, 77.5%), and this group was considerably younger ($p<0.001$) with a mean age of 78.4 (±7.7) years when compared with the group from nursing homes (n=150, 22.5%) where the mean age was 85.3 (±7.4) years.

Two-thirds of the study group (n=447; 67.0%) were treated without surgery. Of these, 303 (67.8%) returned to their previous residence, whereas 144 (32.2%) were transferred to rehabilitation. Two hundred and twenty patients (33.0%) were admitted to the orthopedic unit for surgery. Surgical intervention for one upper extremity fracture was more frequently required in fractures around the elbow (68.6%), forearm (37.5%), and humeral shaft (31.0%). Fractures of the distal radius and proximal humerus were treated less often by operation (23.0% and 21.6%, respectively). The majority of patients (82.5%) with upper and lower extremity fractures underwent surgery; one-third were only operated upon for an additional lower extremity fracture and their upper extremity fracture was treated non-operatively. The post-operative mortality rate was 1.4%. The median length of stay in the orthopedic unit was 12.0 (IQR 8.0-16.0) days.

In total, 248 patients (37.2%) of the study population were transferred to rehabilitation, either directly after being evaluated in the emergency department or after surgery. Their median length of stay was 46.0 (IQR 26.0-69.0) days, with no difference as regards treatment (operative or non-operative). Twelve patients (4.8%) died during their period of rehabilitation. At the end of the follow-up period, thirty-one patients (6%), living independently prior to their fracture, now required permanent nursing home care. This group of patients was distinguished by their advanced age (84.4±6.7 years).

In order to evaluate the factors leading to inpatient rehabilitation care, we compared the data of patients returning directly to their previous residence with those requiring rehabilitation, specifically looking at age, gender, previous place of residence, treatment type, anatomic site of fracture, and whether the patient had sustained one or two fractures. Table 2 shows that the use of inpatient care was nearly twice as high (63.9% *vs* 32.6%; OR=3.66) in patients sustaining two fractures. Patients with one fracture were more likely to require rehabilitation when they were 80 years of age or older (OR adj.=3.29), came from private homes (OR adj.=3.16), sustained a fracture of the humerus (OR adj.=2.31) or after surgery (OR adj.=1.59). Women tended to be hospitalized more often than men (OR adj.=1.59).

Age and previous residence appeared to be the most important determinants for the use of rehabilitation, and Figure 1 illustrates a significant increase with age ($p<0.001$). In order to see whether the determinants differed for patients under and over 80 years of age, we analyzed the absolute increase in the use of rehabilitation care (17.4%) due to older age, and then assessed the difference between related variables (Table 3). The use of further care increased markedly for patients over 80 years of age coming from private homes (24.1%, 95% CI 4.1-44.0) and for patients with one

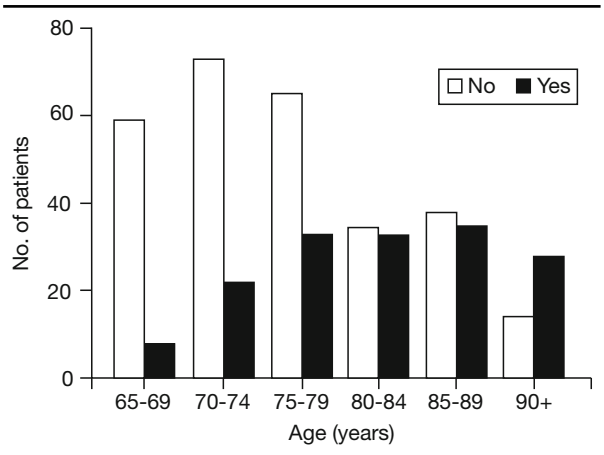

Fig. 1 - *Rehabilitation care utilization according to age.*

fracture (21.0%, 95% CI 0.3-41.8); the need among those with two fractures was unaffected by age. In women, the increase tended to be more important than in men (13.5%, 95% CI 7.5-34.9).

DISCUSSION

Upper extremity fractures in the elderly are frequent. We found that the most common sites involved are the distal radius, proximal humerus, and fractures around the elbow, as in previous investigations (4, 6, 11, 12, 15). Similar to many reports in the literature (3, 5, 6, 8, 9, 15), we found that a much higher percentage of women as opposed to men sustained fractures of the upper extremity.

Most of the fractures of the upper extremity in our study population were treated non-operatively. This is in agreement with the treatment plans described in the orthopedic literature (16-19), and hospitalization and convalescence is usually not required. Even for patients hospitalized for surgery, from the orthopedic point of view the majority should be able to return to their previous residence after discharge.

Our study found that more than one-third of patients (37.2%) with an upper extremity fracture required rehabilitation for further inpatient care. It is this group which is most important to consider in terms of medical, social and economic aspects. This is particularly of importance with the projected more than two-fold increase in the number of persons over the age of 65 years between 1990 and 2030 (20) and the concomitant increase in such fractures (21). Age is an important factor in determining the use of inpatient care, especially among persons living independently prior to their fracture. Of the patients over the age of 80 years, 45% required lengthy inpatient rehabilitation care, as did more than half those with fractures of the humerus. The fact of already being institutionalized is associated with lower use of further rehabilitation care, despite the older age of this group of patients. This has been noted by others (1). As one would expect, patients with two fractures had a higher risk of requiring further inpatient care – a finding that was unaffected by age in our study. However, the frequency of this type of injury pattern (14.5%) was not very high.

These results indicate that the use of extended inpatient care in elderly patients with one fracture is more related to general health and social conditions (living conditions and disability due to advanced age) rather than to the particular orthopedic injury and consequent treatment. This has already been described. Lind et al. (8) reported that the major reason for hospitalizing patients with fractures of the proximal humerus was for social reasons. In that review, on-

Table 3 - *Rehabilitation care utilization stratified by age.*

	Age <80 yrs		Age ≥80 yrs			
	Total (n=323)	**Rehabilitation required (%)**	**Total (n=344)**	**Rehabilitation required (%)**	**Absolute increase due to older age (%)**	**% Difference (95% CI)**
Gender						
Men	40	27.5	51	33.3	5.8	
Women	283	28.3	293	47.8	19.5	13.5 (–7.5-34.9)
Prev. residence						
Nursing home	31	19.4	119	23.5	4.1	
Private home	292	29.1	225	57.3	28.2	24.1 (4.1-44.0)
Type of injury						
Two Fractures	35	65.7	62	62.9	–2.8	
One Fracture	288	23.6	282	41.8	18.2	21.0 (0.3-41.8)
Fracture site*						
Others	186	18.8	161	32.9	14.1	
Humerus	102	32.4	121	53.7	21.3	7.2 (–8.1-22.6)
Treatment*						
Non-operative	188	21.8	228	39.0	17.2	
Operative	100	27.0	54	53.7	26.7	9.5 (–8.1-27.1)

*Only including patients with one upper extremity fracture (n=570).

Aging Clin Exp Res 17: 276-280, 2005
©2005, Editrice Kurtis

ly 21% of patients admitted to emergency with this diagnosis underwent surgery.

We compared our results in upper extremity fractures with those of a study of 404 patients with hip fractures who presented to our hospital over a one-year period (1). Although after hip fracture patients more often required rehabilitation care (67.0%) than those after upper extremity fractures (37.2%), the use of inpatient care was in itself higher than what might have been expected in patients with an upper extremity fracture. The median length of stay in rehabilitation care was lengthy for both groups (57 days for those with hip fractures, 46 days for those with upper extremity fractures). This confirms the work of others, particularly with reference to proximal humerus fractures (13), where the mean length of hospitalization was second only to hip fractures in the mean number of hospital days it caused. The percentage of patients with hip fractures requiring a permanent change in their place of residence was higher than for those with upper extremity fractures (18 *vs* 6%, respectively).

This study has obvious strengths, such as the size of the patient population and the ability to track closely their pathway from arrival in the emergency department through their stay in rehabilitation and eventual place of living. We also acknowledge its limitations. This was a retrospective study and we did not have sufficient information regarding patients' social situation before injury. Additionally, from an orthopedic viewpoint, we did not relate the use of inpatient care to the type of operative treatment afforded to the patients. We do recognize that certain types of procedures may render a patient more functional earlier, thus obviating the need for much inpatient rehabilitation care. We also did not have complete information regarding pre-existing co-morbidites and diseases which arose during hospitalization. But, clearly, the reason for presentation to the emergency department was a fracture of the upper extremity and not a medical problem. Furthermore, we realize that the management of health care among the elderly differs from one country to another, and that therefore post-fracture treatment may include rehabilitation care utilization, as in our study, or utilization of other structures such as nursing homes, home-care programs, etc.

CONCLUSIONS

Fractures of the upper extremity in the elderly population, especially in those over 80 years of age, often require prolonged periods of hospitalization, thus accounting for considerable health care costs. In some patients, this results in a permanent loss of independent living. We believe that the significance of this problem is underestimated. Factors contributing to maintaining these patients in their previous place of residence, such as home-care nursing, physical therapy, and overall social support, need to be more thoroughly implemented in order to avoid long-term hospital stays.

REFERENCES

1. Schurch MA, Rizzoli R, Mermillod B, Vasey H, Michel JP, Bonjour JP. A prospective study on socioeconomic aspects of fracture of the proximal femur. J Bone Miner Res 1996; 11: 1935-42.
2. Riggs BL, Melton LJ, 3rd. The worldwide problem of osteoporosis: insights afforded by epidemiology. Bone 1995; 17: S505-11.
3. De Laet CE, Pols HA. Fractures in the elderly: epidemiology and demography. Baillières Best Pract Res Clin Endocrinol Metab 2000; 14: 171-9.
4. Barrett JA, Baron JA, Karagas MR, Beach ML. Fracture risk in the U.S. Medicare population. J Clin Epidemiol 1999; 52: 243-9.
5. Baron JA, Karagas M, Barrett J, et al. Basic epidemiology of fractures of the upper and lower limb among Americans over 65 years of age. Epidemiology 1996; 7: 612-8.
6. Baron JA, Barrett JA, Karagas MR. The epidemiology of peripheral fractures. Bone 1996; 18: S209-13.
7. Kroner K, Lind T, Jensen J. The epidemiology of shoulder dislocations. Arch Orthop Trauma Surg 1989; 108: 288-90.
8. Lind T, Kroner K, Jensen J. The epidemiology of fractures of the proximal humerus. Arch Orthop Trauma Surg 1989; 108: 285-7.
9. Sarkar MR, Hoellen IP, Kinzl L. Fractures of the upper extremity in the elderly. Z Orthop Ihre Grenzgeb 1999; 137: 486-91.
10. Lee SH, Dargent-Molina P, Breart G. Risk factors for fractures of the proximal humerus: results from the EPIDOS prospective study. J Bone Miner Res 2002; 17: 817-25.
11. Nguyen TV, Center JR, Sambrook PN, Eisman JA. Risk factors for proximal humerus, forearm, and wrist fractures in elderly men and women: the Dubbo Osteoporosis Epidemiology Study. Am J Epidemiol 2001; 153: 587-95.
12. Seeley D, Browner W, Nevitt M, Genant H, Scott J, Cummings S. Which fractures are associated with low appendicular bone mass in elderly women? Ann Intern Med 1991; 115: 837-42.
13. Lippuner K, von Overbeck J, Perrelet R, Bosshard H, Jaeger P. Incidence and direct medical costs of hospitalizations due to osteoporotic fractures in Switzerland. Osteoporos Int 1997; 7: 414-25.
14. Randell A, Sambrook PN, Nguyen TV, et al. Direct clinical and welfare costs of osteoporotic fractures in elderly men and women. Osteoporos Int 1995; 5: 427-32.
15. Nordell E, Jarnlo GB, Jetsen C, Nordstrom L, Thorngren KG. Accidental falls and related fractures in 65-74 year olds: a retrospective study of 332 patients. Acta Orthop Scand 2000; 71: 175-9.
16. Court-Brown CM, Garg A, McQueen MM. The translated two-part fracture of the proximal humerus. Epidemiology and outcome in the older patient. J Bone Joint Surg Br 2001; 83: 799-804.
17. Court-Brown CM, Cattermole H, McQueen MM. Impacted valgus fractures (B1.1) of the proximal humerus. The results of non-operative treatment. J Bone Joint Surg Br 2002; 84: 504-8.
18. Ilchmann T, Ochsner PE, Wingstrand H, Jonsson K. Non-operative treatment versus tension-band osteosynthesis in three- and four-part proximal humeral fractures. A retrospective study of 34 fractures from two different trauma centers. Int Orthop 1998; 22: 316-20.
19. Zyto K, Ahrengart L, Sperber A, Tornkvist H. Treatment of displaced proximal humeral fractures in elderly patients. J Bone Joint Surg Br 1997; 79: 412-7.
20. National Aging Information Center. Aging into the 21st century. 2001.
21. Kannus P, Palvanen M, Niemi S, Parkkari J, Jarvinen M, Vuori I. Osteoporotic fractures of the proximal humerus in elderly Finnish persons: sharp increase in 1970-1998 and alarming projections for the new millennium. Acta Orthop Scand 2000; 71: 465-70.